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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Yonjun Jeff Hu

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08/17/2004

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EXAMINER

COLEMAN, WILLIAM D

ART UNIT

PAPER NUMBER

2823

DATE MAILED: 08/17/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

09/896,093

Applicant(s)

HU, YONJUN JEFF

Examiner

W. David Coleman

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 19 May 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-90 and 145-154 is/are pending in the application.
- 4a) Of the above claim(s) 1-36 and 145-154 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 42 is/are allowed.
- 6) ☒ Claim(s) 37-41 and 43-50 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

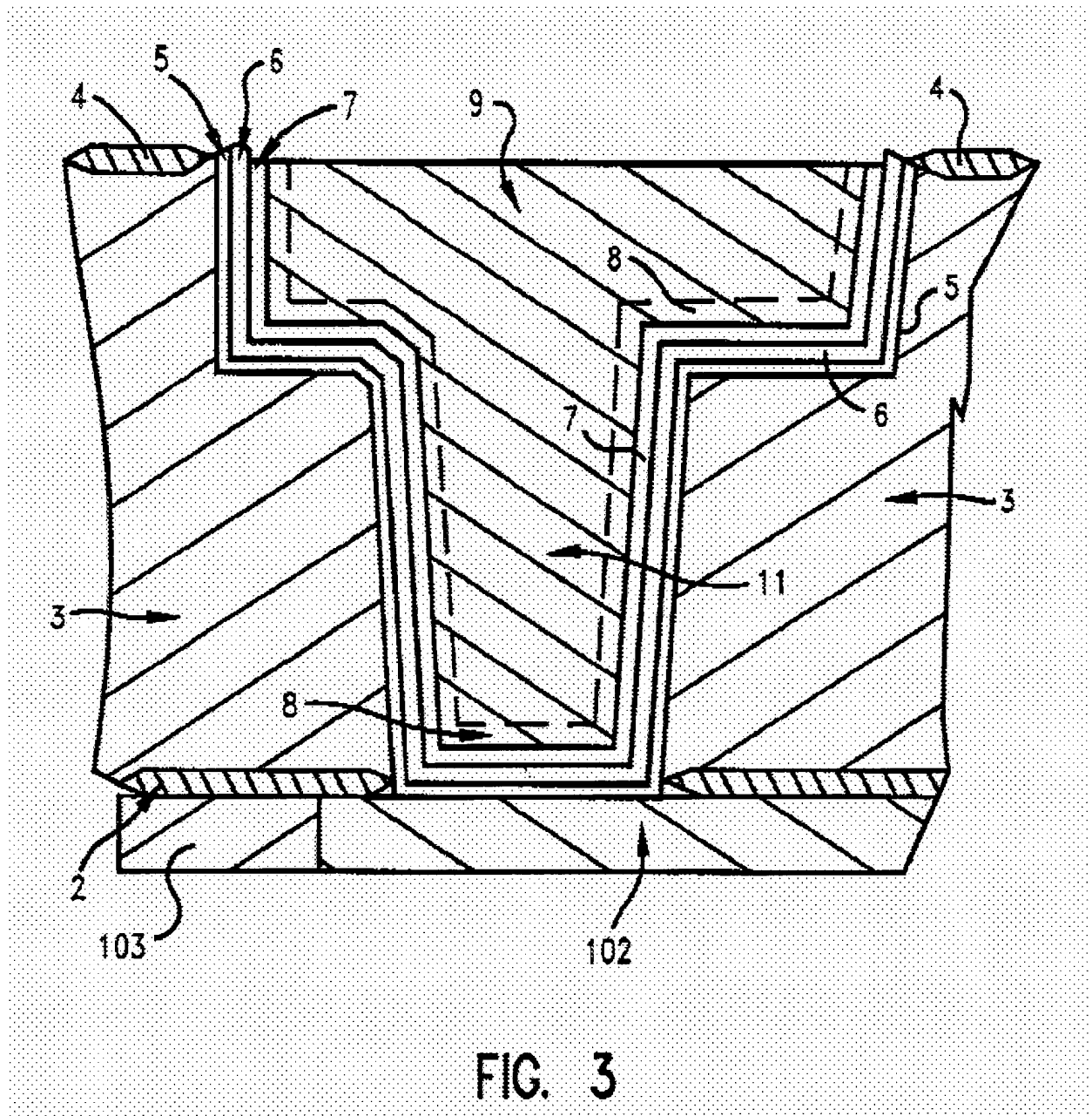
### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Response to Arguments***

1. Applicant's arguments filed May 19, 2004 have been fully considered but they are not persuasive.
2. Applicant contends that the prior art reference Rathore et al., U.S. Patent 6,258,70 B1 herein known as Rathore fails to teach forming a nitrided metal layer on a diffusion barrier layer, where the nitrided metal layer has a first metal component, a second metal component capable of forming a crystalline compound with the first metal component, and nitrogen where the second metal component has a surface energy lower than a surface energy of the first metal component, and where the nitrided metal layer is rich in the first metal component as in claim 37.
3. In response to applicant's contention that Rathore fails to disclose forming a nitrided metal layer on a diffusion barrier layer, where the nitrided metal layer has a first metal component, a second metal component capable of forming a crystalline compound with the first metal component, and nitrogen where the second metal component has a surface energy lower than a surface energy of the first metal component, and where the nitrided metal layer is rich in the first metal component as in claim 37, Applicant is directed to FIG. 3, where Rathore teaches the claimed invention.



4. Element 5 is the diffusion barrier comprised of titanium. It is well known that the metal titanium is used as diffusion barrier. Although it is called an adhesion layer by Rathore, it performs the function as a diffusion barrier. The nitrided layer as claimed is described in Rathore as element 6. Please note that Rathore teaches that thereafter there is deposited an

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optional thermal diffusion barrier layer 6, typically 200 to 400 angstroms thick, of material such as chromium-chromium oxide, tungsten-silicon, tungsten-nitride, tungsten-nitride-silicon, titanium nitride, tantalum or tantalum-nitride (column 8, lines 5-9). The examiner take the position that the surface energy of titanium 7, which forms an inter-metallic compound has a lower surface energy than the titanium-nitride layer 6, therefore Applicant's arguments are moot.

5. Applicant contends that the term "capable of forming a crystalline compound with the first metal component" serves to further describe the second metal component and is not a process step of claim 37.

6. In response to Applicant's contention that the term "capable" is not a process step. It is highly advised that since the claims are directed to a process the term "capable" should be removed since the term can be equated with the term "possibility", being such that the term "capable" could not be patentably enforced.

***Claim Rejections - 35 USC § 102***

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

8. The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) and the Intellectual Property and High Technology Technical Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting directly or indirectly from an international application filed before November 29, 2000. Therefore, the prior art date of the

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reference is determined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

9. Claims 37-40 and 44-50 are rejected under 35 U.S.C. 102(e) as being anticipated by Rathore et al., U.S. Patent 6,258,710 B1.

10. Rathore discloses a semiconductor process as claimed. See **FIGS. 1-8**, where Rathore teaches the claimed invention.

11. Pertaining to claim 37, Rathore teaches a method of forming a metal interconnect in an integrated circuit device, the method comprising:

forming a diffusion barrier layer **5** (titanium or titanium nitride) on a base layer **102**;  
forming a nitrided metal layer **6** on the diffusion barrier layer, wherein the nitrided metal layer comprises a first metal component **6/7**, a second metal component capable of forming a crystalline compound with the first metal component, and nitrogen, wherein the second metal component has a surface energy lower than a surface energy of the first metal component, and wherein the nitrided metal layer is rich in the first metal component;  
forming a second metal layer **8** (also see columns 8 and 9) on the nitrided metal layer, wherein the second metal layer comprises the first metal component; and  
removing excess portions of the second metal layer to define the metal interconnect (column 9, lines 49-50).

12. Pertaining to claim 38, Rathore teaches the method of claim 37, wherein forming a nitrided metal layer further comprises performing a physical vapor deposition process in a nitrogen-containing atmosphere using a physical vapor deposition source containing the first and

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second metal components (please note to form a nitride using a sputtering technique nitrogen is required to form a metal nitride).

13. Pertaining to claim 39, Rathore teaches the method of claim 38, wherein the physical vapor deposition source is a composite source having a first portion containing the first metal component in an elemental state and a second portion containing the crystalline compound of the first and second metal components (column 8, lines 17-23, since the PVD can be a combination of any of the sputtering techniques).

14. Pertaining to claim 40, Rathore teaches the method of claim 39, wherein the first and second portions of the physical vapor deposition source are intermixed (see phantom line for 8).

15. Pertaining to claim 44, Rathore teaches the method of claim 37, wherein the diffusion barrier layer is a titanium-containing layer.

16. Pertaining to claim 45, Rathore teaches the method of claim 37, wherein the diffusion barrier layer is titanium nitride.

17. Pertaining to claim 46, Rathore teaches the method of claim 37, wherein the first metal component is selected from the group consisting of copper, silver, gold, palladium, platinum, rhenium, iridium, ruthenium and osmium.

18. Pertaining to claim 47, Rathore teaches the method of claim 37, wherein the second metal component is selected from the group consisting of scandium, yttrium, lanthanum, titanium, zirconium and hafnium (column 8, lines 35-38).

19. Pertaining to claim 48, Rathore teaches the method of claim 37, wherein forming a second metal layer on the nitrided metal layer further comprises forming a seed layer on the

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nitrided metal layer and forming a metal layer on the seed layer, and wherein the seed layer and the metal layer each contain the first metal component.

20. Pertaining to claim 49, Rathore teaches the method of claim 48, wherein the seed layer consists essentially of the first metal component.

21. Pertaining to claim 50, Rathore teaches the method of claim 37, wherein the base layer is selected from the group consisting of a semiconductor substrate and a conductor layer.

***Claim Rejections - 35 USC § 103***

22. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

23. Claims 41 and 43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rathore et al., U.S. Patent 6,258,710 B1.

24. Rathore discloses a semiconductor process substantially as claimed as discussed above.

25. Pertaining to claim 41, Rathore fails to teach the method of claim 37, wherein forming a nitrided metal layer further comprises sputtering a composite target in a nitrogen-containing atmosphere, wherein the composite target has a first portion containing the first metal component in an elemental state and a second portion containing the crystalline compound of the first and second metal components, and wherein the nitrogen-containing atmosphere comprises approximately 5% to 30% by volume of nitrogen in an inert gas.

26. Given the teaching of the references, it would have been obvious to determine the optimum thickness, temperature as well as condition of delivery of the layers involved. See *In re*



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*Aller, Lacey and Hall* (10 USPQ 233-237) “It is not inventive to discover optimum or workable ranges by routine experimentation. Note that the specification contains no disclosure of either the critical nature of the claimed ranges or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. *In re Woodruff*, 919 f.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Any differences in the claimed invention and the prior art may be expected to result in some differences in properties. The issue is whether the properties differ to such an extent that the difference is really unexpected. *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986)

Appellants have the burden of explaining the data in any declaration they proffer as evidence of non-obviousness. *Ex parte Ishizaka*, 24 USPQ2d 1621, 1624 (Bd. Pat. App. & Inter. 1992).

An Affidavit or declaration under 37 CFR 1.132 must compare the claimed subject matter with the closest prior art to be effective to rebut a prima facie case of obviousness. *In re Burckel*, 592 F.2d 1175, 201 USPQ 67 (CCPA 1979).

27. Pertaining to claim 43, Rathore teaches the method of claim 41, wherein the inert gas is argon (column 10, line 40).

### ***Claim Rejections - 35 USC § 112***

28. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

29. Claim 37 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The term “capable” is a mental step. It is not clear as to Applicants process steps that a crystalline compound is actually formed.

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***Allowable Subject Matter***

30. Claim 42 allowed.

31. The following is an examiner's statement of reasons for allowance: prior art does not anticipate nor render obviousness as to the composite target are intermixed..

32. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

***Conclusion***

33. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

34. A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

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35. Any inquiry concerning this communication or earlier communications from the examiner should be directed to W. David Coleman whose telephone number is 571-272-1856.

The examiner can normally be reached on 9:00 AM-5:00 PM.

36. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 571-272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

37. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



W. David Coleman  
Primary Examiner  
Art Unit 2823

WDC